

WE CLAIM:

1. In a hard drive assembly having an actuator, the actuator having an actuator voltage, a method of controlling the actuator comprising the steps of:
 - sampling the actuator voltage;
 - processing an actuator voltage sample for generating a digital voltage command;
 - applying the digital voltage command to control the actuator voltage.
2. A method according to claim 1 wherein the sampling step further comprises converting of an analog actuator voltage into a digital actuator voltage sample signal.
3. A method according to claim 1 wherein the step of applying the digital voltage command to control the actuator voltage further comprises converting the digital voltage command into an analog voltage level.
4. A method according to claim 1 wherein the step of applying the digital voltage command to control the actuator voltage further comprises using pulse width modulation.
5. A method according to claim 1 wherein the step of sampling the actuator voltage further comprises steps of:
 - putting the actuator in a high impedance state;
 - waiting for an actuator current to reach approximately zero; and
 - thereafter sampling the actuator voltage.

6. A method according to claim 1 wherein the step of processing the digital actuator voltage sample for generating a digital voltage command further comprises steps of calculating a velocity error and applying velocity error compensation to the digital voltage command.

7. In a hard drive assembly having an actuator, the actuator having an actuator voltage, a method of controlling the actuator according to claim 1 further comprising steps of, subsequent to the applying step, waiting for a selected time interval and reiterating the sampling, processing, and applying steps.

8. In a hard drive assembly having an actuator, the actuator having an actuator voltage, a method of controlling the actuator comprising the steps of:

- sampling the actuator voltage;

- sampling an actuator current;

- calculating a BEMF using the sampled actuator voltage and sampled actuator current;

- calculating a velocity error using the BEMF and a selected target voltage;

- producing a digital voltage command for compensating the actuator voltage for the velocity error; and

- applying a voltage at the actuator according to the digital voltage command.

9. A method according to claim 8 wherein the step of calculating a BEMF may be described by the formula,

$$\text{BEMF} = \text{Vmtr} - \text{Imtr} * \text{Rmtr} \quad [\text{Equation 2}], \text{ wherein}$$

Vmtr represents actuator motor voltage,

Imtr represents actuator current, and

Rmtr represents actuator motor resistance.

10. A method according to claim 8 wherein the step of calculating a velocity error, E_v , may be described by the formula,

$$E_v = V_{tgt} - \text{BEMF} \quad [\text{Equation 3}], \text{ wherein}$$

V_{tgt} represents target actuator voltage, and

BEMF represents the actual voltage across the actuator.

11. A method according to claim 8 wherein the digital voltage command, V_{cmd} , may be described by the formula,

$$V_{cmd} = k_i * [x(n) + x(n-1)] + y_i(n-1) + k_p * x(n) + \text{ffwd} \quad [\text{Equation 4}],$$

wherein,

k_i is a constant representing the magnitude of integral compensation to apply,

$x(n)$ is a sample of the current value of the error term E_v ,

y_i represents the output of the integral portion of the compensation, and

ffwd represents a feed forward voltage that allows the loop to run with a zero error within the dynamic range of the integrator.

12. In a hard drive assembly having an actuator, the actuator having an actuator voltage, a method of controlling the actuator according to claim 8 further comprising the steps of, subsequent to the applying step, waiting for a selected time interval and reiterating the foregoing steps.

13. A velocity-controlled actuator apparatus in a hard drive assembly having an actuator motor, the velocity-controlled actuator apparatus comprising:

- a sampler for sampling an actuator motor voltage and outputting a digital actuator motor voltage sample;

- a timer for periodically activating the sampler; and

- a digital processing engine for receiving a target actuator voltage command and the digital actuator motor voltage sample and for outputting a digital voltage command for controlling the actuator motor.

14. A velocity-controlled actuator apparatus according to claim 13 wherein the timer is further adapted for putting the actuator motor in a high impedance state.

15. A velocity-controlled actuator apparatus according to claim 13 further comprising a digital-to-analog converter for receiving the digital processing engine digital voltage command and outputting an analog voltage.

16. A velocity-controlled actuator apparatus according to claim 13 further comprising an analog-to-digital converter operatively coupled to the actuator motor and sampler for sampling an analog actuator voltage and providing a digital signal to the sampler.

17. A velocity-controlled actuator apparatus according to claim 13 wherein the digital processing engine further comprises a gain component for providing a pre-selected output gain.

18. A velocity-controlled actuator apparatus according to claim 13 wherein the digital processing engine further comprises an integrator for calculating the digital voltage command.

19. A velocity-controlled actuator apparatus according to claim 13 wherein the digital processing engine further comprises a digital processing engine shared by other functions in the hard drive assembly.

20. A velocity-controlled actuator apparatus according to claim 13 wherein the digital processing engine further comprises machine readable instructions according to Table 1.

21. A velocity-controlled actuator apparatus according to claim 13 wherein the digital processing engine further comprises machine readable instructions according to Table 2.

22. A velocity-controlled actuator apparatus according to claim 13 wherein the digital processing engine further comprises machine readable instructions according to Table 3.